WARREN COUNTY SOILS

By HERMAN WASCHER
and R. S. SMITH

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"It must be remembered that the productive power of the soil is the basic support of all prosperity."
—C. G. HOPKINS

"It is the duty of every landowner to see that his land when he leaves it is as good or better than when he received it."—J. G. MOSIER

INTRODUCTORY NOTE

IT IS A MATTER of common observation that soils vary tremendously in their productive power, depending upon their physical condition, their chemical composition, and their biological activities. *For any comprehensive plan of soil improvement* looking toward the permanent maintenance of our agricultural lands, a definite knowledge of the various existing kinds or types of soil is a first essential. It is the purpose of a soil survey to classify the various kinds of soil of a given area in such a manner as to permit definite characterization for description and for mapping. With the information that such a survey affords, every farmer or landowner of the surveyed area has at hand the basis for a rational system for the improvement of his land. At the same time the Experiment Station is furnished a scientific inventory of the soils of the state; and with such an inventory as a basis it can proceed intelligently to plan those fundamental investigations so necessary for the solution of problems of practical soil improvement.

This county soil report is one of a series reporting the results of the soil survey which, when completed, will cover the state of Illinois. Each county report is intended to be as nearly complete in itself as it is practicable to make it, even at the expense of some repetition.

While the authors must assume the responsibility for the presentation of this report, it should be understood that the material for it represents the contribution of a considerable number of the present and former members of the Agronomy Department working in their respective lines of soil mapping, soil analysis, and experiment field investigation.

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WARREN COUNTY SOILS

By Herman Wascher and R. S. Smith[1]

GEOGRAPHICAL AND HISTORICAL FEATURES

WARREN COUNTY lies in the western part of Illinois on the drainage divide between the Mississippi and Illinois rivers. It is rectangular in shape—about 18 miles from east to west and 30 miles from north to south—and occupies an area of approximately 535 square miles. It was established by legislative act January 13, 1825, and was named in honor of Joseph E. Warren, a general in the Revolutionary War.

The first permanent settlements in the county were made in the spring of 1828 along Henderson creek in Kelly township. Within two years the population had increased to 308, which was sufficient for a commission to be appointed to choose a

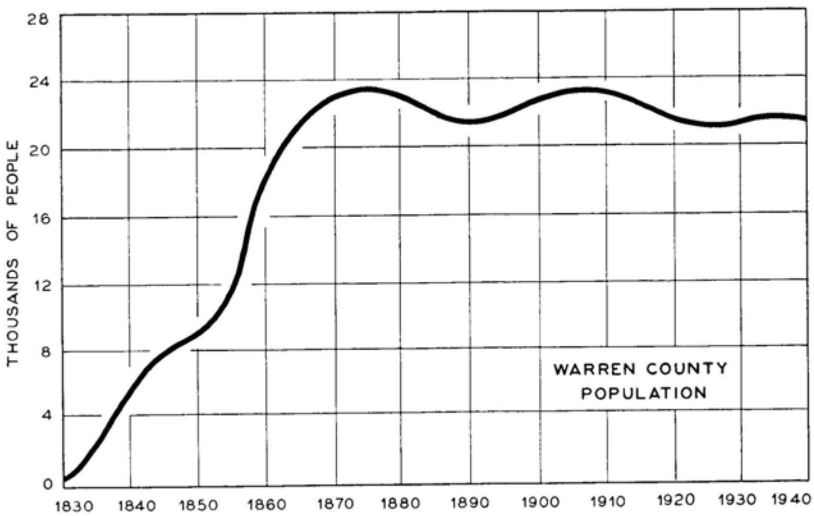

Fig. 1.—Population Trend in Warren County

The rapid increase in population in Warren county from 1830 to 1870 is typical of many Illinois counties, but the decline during the later decades has not been so marked as in many other counties.

site for the county courthouse. This commission chose a portion of Section 29, Monmouth township, because it seemed to be nearest the center of population; and Monmouth, now the principal city as well as the county seat, was built around this site. In later years Monmouth was often called the "Maple City" because of the large number of maple trees lining its streets.

When first established, Warren county also included the territory that is now Henderson county. But when a difference of opinion arose over the permanent location of the courthouse, the settlers in the western half of the county organized

[1]Herman Wascher, Assistant Chief in Soil Survey; and R. S. Smith, Chief in Soil Physics and Soil Survey.

a separate government. This was recognized by the state in 1841, when Henderson county was formed.

According to the U. S. Census, the population of Warren county increased rapidly following the close of the Black Hawk War, until by 1870 there was a total of 23,200 inhabitants. Since that time the number has remained relatively constant, fluctuating between 21,300 and 23,300 (Fig. 1).

Facilities for the marketing of agricultural products are well established in this part of the state. Direct routes by railroad are available to Kansas City and Chicago and to other important points in Missouri, Iowa, and Illinois. No farm in the county is more than 8 miles from a paved highway.[1] Considerable progress has been made since 1932 in the improvement of tributary country roads, so that at the present time most of the county is fairly well supplied by some form of all-weather road.

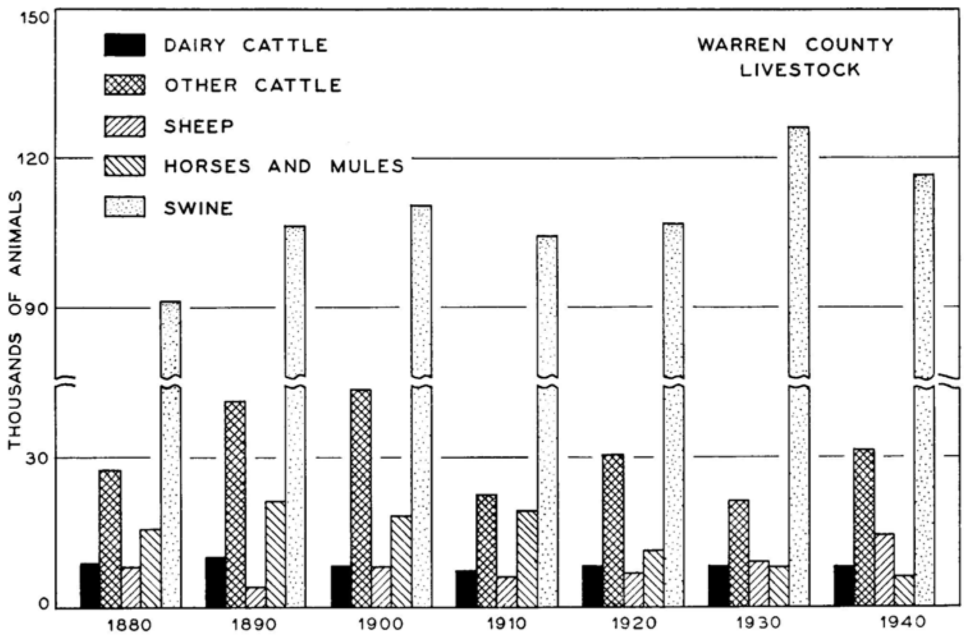

FIG. 2.—PRODUCTION OF PRINCIPAL CLASSES OF LIVESTOCK IN WARREN COUNTY

For the past sixty years the production of livestock has fluctuated within rather narrow limits. Two exceptions are a notable increase in the number of sheep in 1940 and a consistent decline since 1910 in the number of horses and mules.

Agricultural Production[2]

Agriculture is the chief source of economic wealth in Warren county. The principal crops grown and the principal livestock products marketed are those

[1]Subsequent to the printing of the soil map for Warren county, Route 94A was changed to 164; Nos. 94B and 3 were changed to 135; and No. 124 was changed to 116.

[2]All crop and livestock statistics are from either the U. S. Census or *Illinois Crop and Livestock Statistics*, Illinois Crop Reporting Service, Illinois Department of Agriculture cooperating with the U. S. Department of Agriculture.

common to the corn belt. Corn is the major crop both in acreage and in value, but wheat, oats, soybeans, and hay are also important. For the fifteen- year period 1924-1938 inclusive the average yearly acreage of the important crops was as follows: corn 126,800 acres; oats 44,900 acres; hay 27,700 acres; soybeans 8,200 acres; wheat 7,900 acres; sweet clover 2,700 acres, and alfalfa 1,500 acres. The acreages of all crops except wheat and soybeans have remained relatively stable thruout this fifteen-year period. Wheat, however, declined from 21,200 acres in 1924 to 7,100 acres in 1938, while the soybean acreage increased from less than 1,000 acres in 1927 to 14,200 acres in 1938.

According to the U. S. Census, there were 271,171 acres of land in Warren county available for crops in 1939. Of this amount 199,646 acres were harvested, of which 107,601 acres, or 53.8 percent, were harvested by tenant farmers. There were 68,600 acres of original forest area in Warren county, but only 9,905 acres remained as woodland in 1934.

Some idea of the trend in livestock production may be gained from Fig. 2, in which the numbers of cattle, sheep, horses and mules, and swine are graphically presented by ten-year intervals beginning with 1880. Altho the number of dairy cattle decreased about 13 percent from 1929 to 1939, milk production remained nearly constant at about 4 million gallons a year. Poultry and egg production have also been an important source of farm income, as indicated by the fact that nearly a million dozen eggs were produced in 1939. Fruit and vegetable production is of minor importance in Warren county.

Climate

The climate of Warren county is representative of that prevailing in the north-central United States. It is characterized by a wide range in temperature between the extremes of winter and summer and by an irregularly distributed but relatively abundant rainfall. In the following paragraphs certain temperature, frost, and rainfall data are presented which are based on records of the Monmouth Weather Station for the twenty-five years, 1915 to 1939, inclusive.

The mean summer temperature during this period was 73.2° F., the mean winter temperature was 29.6° F., and the average mean yearly temperature was 51.1° F. The highest temperature recorded was 110° F. in July, 1936, and the lowest –22° F. in January and December, 1924.

The average date of the last killing frost in the spring, according to these records, is April 27, the date of the first killing frost in the fall October 13. This gives an average frost-free season of 169 days, which ordinarily provides ample time for the corn crop to reach maturity. The latest recorded killing frost in the spring was on May 25, 1925, and the earliest in the fall was on September 20, 1918. The shortest growing season, 138 days, occurred in 1925. The longest growing season, 198 days, was in 1938.

The average annual precipitation at Monmouth for this same twenty-five-year period was 35.83 inches. This includes the water melted from an average annual snowfall of 25 inches, about 10 inches of snow being equivalent to an inch of rainfall. The driest year in this period was 1930, when the total precipitation was 25.0 inches; 1929 was the wettest year, with 49.9 inches. The driest month, on the average, was February, with precipitation of only 1.38 inches. June and Sep-

tember were the wettest months, with an average of 5.16 inches and 4.11 inches respectively; while April, May, July, and August all averaged 3 inches or more.

The above average figures would seem to indicate adequate rainfall thruout the growing season, April thru September; but the fact is that rainless periods of sufficient length to be harmful occur at rather frequent intervals. During the above-mentioned twenty-five-year period there were 51 rainless periods of 21 days or more during the growing season, according to data from the Monmouth Weather Station. A rainless period, as the term is used in this report, is one in which no rain totaling more than ½ inch falls during any 24 hours. Of these 51 rainless periods 25 exceeded 30 days, while one in 1920 lasted 86 days and another in 1936 lasted 83 days.

When 30 days or more elapse without rain during a critical period of crop growth, some injury is likely to result. This is especially true on soils low in organic matter and having a low water-holding capacity. Rainless periods of less than 21 days probably do little permanent harm, especially on the more productive soils, tho corn and even oat crops are known to have been damaged by rainless periods of as short duration as three weeks when accompanied by several days of dry hot winds.

Thus neither the total monthly nor total yearly precipitation is a good index to the amount of available moisture that may be present in the soil at any specific time—departures from the average are too frequent and too wide. Furthermore the rate of precipitation, rate of evaporation, absorptive and retentive capacity of the soil, as well as other soil characteristics and certain plant characteristics, are important factors influencing the amount of moisture available.

Topography and Drainage

The prevailing topography of Warren county is essentially that of a flat plain which has been fairly well dissected by the headwater erosion of numerous streams and small drainage lines. It is only in the northern and the extreme southern parts of the county that remnants of a few distinct ridges occur which are not directly related to stream erosion. Those in the northern end of the county are already partially obliterated by the uneven topography along Henderson and Cedar creeks.

Much of the northwestern and southeastern portions of Warren county are so strongly dissected that little of the original flat plain remains. Here surface drainage is fairly rapid, for the most part, and artificial drainage plays a minor role in the removal of excess water. Thru the central part of the county, however, and particularly in the southwestern portion, many areas of flat land remain which must be provided with artificial drainage if farming operations are to be carried on successfully.

The lowest points in Warren county are the Henderson creek and Cedar creek bottoms at the Henderson county border, which are 579 feet above sea level. The highest point is an elevation of 801 feet near Colfax school in Point Pleasant township. Thus the maximum range in relief for the county is 222 feet. In the dissected areas, however, the general range is from about 600 feet in the bottomlands to about 720 feet at the margins of the flat tablelands, while the height of the tablelands varies from about 730 to 780 feet.

FORMATION OF WARREN COUNTY SOILS

Origin of Soil Material

The nature of Warren county soils can be more readily understood if something is known of the formation and composition of the materials from which they have been derived. The upland and terrace soils have developed from materials deposited during and immediately following glacial times, while the bottomland sediments have been reworked and more or less assorted, and deposited by the streams during recent times.

The Glacial Epoch was marked by several changes in climate. During the colder intervals snow and ice accumulated in the northern parts of the continent in such vast quantities that pressure developed in the masses caused them to push outward from their centers of accumulation, forming glaciers. The glaciers, aided by further accumulations of snow and ice at their margins, moved southward until the temperature was such that the ice melted rapidly enough to stop further progress.

The tremendous force exerted by the advancing ice gouged out basins, leveled off hills, and filled in valleys, and thus often completely obliterated the former features of the surface over which the glacier passed. The mixed rock debris, part of which existed before the advance of the glacier and part of which was formed by its advance, was gathered up and sometimes carried for hundreds of miles. When a warmer period occurred, the ice melted, and the rock fragments and other debris, much of which had been ground very fine, were deposited over the areas which the ice occupied. This rock debris is called "glacial till" or simply "till."

There were four great periods during which ice sheets moved down from the north. These movements were separated by long intervals during which the climate was warm enough for the country to become clothed with vegetation. The third advance of the ice, called the Illinoian, covered all the area that is now Warren county, and upon melting back, left a broad and relatively level till plain which, together with subsequent erosion, was largely responsible for the present surface topography. During the succeeding warm interval the till was leached of its lime to a depth of several feet, and the upper portion was weathered into soil. This old soil and leached till may be readily identified in many of the deep cuts made by road and railroad workers and by streams.

The ice of the fourth and last movement, called the Wisconsin, did not touch any part of Warren county, yet its presence in the near northern regions was of tremendous importance, as it was the source of the material from which the soils of the county were formed. As the ice of the Wisconsin glacier melted, immense quantities of water, carrying clay, silt, sand, and often gravel, poured out over the flat lands just beyond the glacier front and down the stream channels. Whereever the velocity of the water was checked, the load of sand and gravel was dropped, and the resulting deposits formed the present outwash plains and stream terraces. Much of the silt was deposited on the broad bottomland flats of the Illinois and Mississippi rivers, while most of the clay was carried to the lower Mississippi valley and into the Gulf of Mexico. It was these silt flats, particularly those along the Mississippi river in the neighborhood of Mercer and Henderson

counties, that became the source of the material from which the present soils of Warren county were derived.

Presumably each winter when low temperatures checked the melting of the ice sheet, the floodwaters receded, exposing the large silt flats. As soon as these flats were dry, the wind picked up the silty sediment and carried it onto the upland, burying the weathered till and its old soils and forming new deposits of uniformly textured material called "loess." No doubt other sources have contributed small quantities of material to these loess deposits, as the dust storms of 1934 suggest (Fig. 3).

On the nearly level areas in Warren county, where erosion has been negligible, the loessial material averages about 10 feet thick, varying from about 12

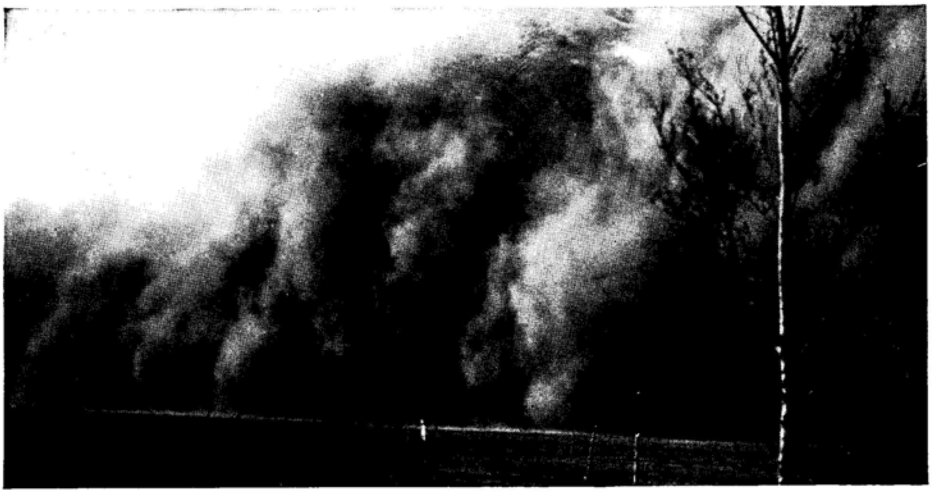

FIG. 3.—LOESS IN THE MAKING

The upland soils of Warren county owe their productivity largely to the silty windblown material called loess, which was deposited near the close of the ice age by dust storms similar to the one pictured above. In this county the Mississippi river bottom was the source of most of the dust. This picture was taken in Texas in the spring of 1935. *(Courtesy U. S. Soil Conservation Service)*

feet in the northwestern part of the county to about 9 feet in the southeastern part. On slopes where erosion has been active, however, the loess is considerably thinner and in some places is entirely absent, so that the leached Illinoian till is exposed. From the weathered loess, including the small areas of exposed till, and the terrace and bottomland sediments, the present soils of Warren county have been developed, and these materials are known as the "parent materials" of the soils of Warren county.

How the Soils Were Developed

When first deposited, the unweathered loess was grayish or pale yellowish in color, silty in texture, of an open porous nature, high in lime content, and amply supplied with the mineral elements of plant food. As weathering forces (oxidation, solution, decomposition, and others) attacked the minerals of the loess,

plant-food compounds were liberated and vegetation spread over the land. With the passage of time this weathering action gradually leached away the free lime, or calcium carbonate, and reduced portions of the silt particles to clay. Thus the process of soil development was begun.

The weathering forces acted differently from place to place because of differences in the slope of the land surface, drainage, type of incoming vegetation, and other factors. As a result, the products formed, which we call soils, began to show differences. As the weathering continued, these differences became more and more pronounced until finally soils with distinctly unlike characteristics were evolved. These dissimilar soils are called "soil types."

In their early stages of development, soil types are strongly under the influence of their parent materials; their distinguishing features are not clearly defined and they are said to be young. As weathering progresses, the characteristics of the different soil types become more clearly defined and the soils are said to be progressing toward maturity and eventually to old age. Most of the soils in Warren county probably would be classed as youthful or in early maturity. If there were any types derived from the leached Illinoian till, they would ordinarily be classified as well advanced or rather old, but the exposed areas of this material are all subject to severe erosion and so do not show any definable soil features.

Three types of vegetation—deciduous forest, prairie, and marsh or swamp—exerted important influence on the soils of Warren county during the time they were developing. Forest vegetation produces a thin accumulation of leaf and twig litter on the surface of the soil; this litter is exposed to the air and therefore decays rather rapidly and completely, supplying little organic matter to the soil. Moreover the roots of trees are coarse, penetrate deeply, and are relatively few in number. As compared with grass roots, they add little to the supply of organic matter when they decay. The soils in this county that have developed under a forest cover are therefore low in organic matter; and their surfaces are usually grayish or yellowish in color.

The grass vegetation of the prairies, on the other hand, produces enormous quantities of fibrous roots which are mostly concentrated in the upper 12 to 18 inches of the soil. Because air does not move freely thru the soil, these roots decay slowly, and when they are decomposed, portions of the residue tend to be preserved for a long period. Since the incorporation of organic matter in the soil produces a dark color, the grassland soils have brownish surface strata.

Marsh vegetation also produces large quantities of fibrous roots. The low-lying pondlike nature of marsh areas is conducive to a more or less permanently high water table which greatly retards the entrance of oxygen, thus slowing up or preventing complete decomposition of the organic matter. Thus immense accumulations of organic matter were preserved in the wet areas of the flat prairies, and the surface strata of these soils became dark brown to black.

Differences in drainage are also responsible for the development of certain features peculiar to each soil type. Soil material in a depression where the water table remains at the surface much of the year develops characteristics distinctly different from those developed from the same material on a hill or in any other place where the water table remains several feet below the surface. The most obvious difference is in color. The poorly drained soil in the depression is gray

because of lack of oxidation of the iron compounds, tho under marsh vegetation the gray color in the surface is sometimes completely hidden by the heavy accumulation of organic matter. The soil developed under good drainage, on the other hand, is yellowish or reddish, tho again the color of the surface horizon is often modified by organic matter.

For simplicity and ease of description, natural drainage is divided into *surface drainage,* which refers to surface runoff, and *underdrainage,* which refers to the passage of water down thru the profile. Underdrainage is determined by the permeability of the subsoil and underlying material. The relative conditions of surface drainage and underdrainage are designated by the terms *excessive, rapid, moderate,* and *slow.* In each case *moderate* stands for the best condition. Moderate surface drainage indicates satisfactory runoff, with little or no erosion; moderate underdrainage indicates relatively free movement of excess ground water to tile but good retention of moisture for plant growth.

In the humid, temperate climate of Illinois a pronounced effect of the weathering of soil material is the production of layers, or horizons, in the soil, each horizon having more or less definite characteristics. From a practical standpoint these various horizons can be described as *surface, subsurface,* and *subsoil.* The *surface* is usually the layer of greatest organic-matter accumulation and ordinarily is about plow depth in thickness, tho it varies considerably according to soil type. The *subsurface* in young soils is generally a zone of gradation between the surface and the subsoil; but in old soils it may be a bleached, highly weathered layer, entirely different from either the overlying surface or the underlying subsoil. The *subsoil* is usually the zone of clay accumulation and consequently is more plastic or sticky than the surface or subsurface horizon above or the parent material below. This condition generally becomes more pronounced as the soils grow older.

All these zones or horizons taken together constitute the "soil profile," and differences in arrangement, color, thickness, or any other of the various physical and chemical features of the respective horizons constitute the basis upon which soil types are differentiated and the soil map constructed.

SOIL CLASSIFICATION AND MAPPING

In the soil survey the "soil type" is recognized as the unit of classification. Each type has definite characteristics upon which its separation from other types is based. These characteristics are inherent in the strata or horizons which taken together constitute the soil profile.

Failure to appreciate the fact that soil types are differentiated on the basis of the character of the *entire* profile and not on the surface alone often makes it difficult to understand exactly what is meant by the term "soil type." It frequently happens that the surface stratum of one type is no different from that of another, and yet the two types may differ widely in character as well as in agricultural value. It is of utmost importance, therefore, in studying descriptions of soil types to get a clear mental picture of *all* the outstanding features of each type.

It is likewise important to understand that a given type must of necessity include a range in properties. The boundaries between soil types are seldom sharp, there frequently being a transitional area or zone which includes some of

the properties of each type. One of the most difficult problems of the soil surveyor is to determine the limits of variability in a given soil type.

Besides the natural range in properties that is found within a given soil type, there are other variations that have been brought about by differences in the management of the soil since it has been under cultivation. For example, the productive capacity of a soil developed on rolling topography may be easily and permanently impaired by management practices which permit soil erosion to go unchecked. Differences of a temporary nature may be induced by poor rotations and other poor farming practices which lower the present productivity of the soil without necessarily impairing the potential or inherent productivity.

TABLE 1.—WARREN COUNTY SOILS: AREAS OF THE DIFFERENT SOIL TYPES

Type No.	Type name	Area in square miles	Area in acres	Percent of total area
8	Hickory gravelly loam, eroded	10.75	6 880	2.01
17	Berwick silt loam	10.12	6 480	1.89
18	Clinton silt loam	83.85	53 660	15.68
36	Tama silt loam	152.27	97 450	28.48
41	Muscatine silt loam	165.96	106 220	31.03
43	Grundy silt loam	41.05	26 270	7.65
44	Monmouth silt loam	3.60	2 300	.67
45	Denny silt loam	.26	170	.05
51	Kern silt loam, terrace	.38	240	.07
65	Grundy clay loam	21.87	14 000	4.09
67	Harpster clay loam	.50	320	.09
73	Huntsville loam, bottom	39.40	25 220	7.38
80	Alexis silt loam, terrace	.63	400	.13
81	Littleton silt loam, terrace	1.31	840	.25
107	Swan clay loam, bottom	.39	250	.07
134	Camden silt loam, terrace	2.08	1 330	.39
139	Hersman silt loam, terrace	.25	160	.05
195	Hersman clay loam, terrace	.06	40	.01
	Pond	.06	40	.01
	Total	534.79	342 270	100.00

A list of the soil types occurring in Warren county is given in Table 1, which shows also the area of each in square miles and in acres and the percentage that each constitutes of the total area of the county. There were 18 types mapped, of which six cover more than 94 percent of the area of the county. For the location and boundary of each soil type see the accompanying soil map.

GENERAL SUGGESTIONS FOR SOIL IMPROVEMENT

The following brief discussion of soil-improvement principles is intended to decrease the necessity for repetition in the *Use and Management* section under each soil type, since the basic principles of soil improvement are similar for many soils. These suggestions for soil improvement, together with the discussion of the productivity of Warren county soils (page 27), it is hoped will help every farmer in the county to maintain and improve the productivity of the soils

on his farm. The discussion is based on the assumption that adequate drainage has been established and that the principal cash crop is corn.

Each soil type has a "productive level" for each crop. This level represents the average yield of a crop over a period of years and under a specific set of conditions and will vary as management practices vary. Low crop yields do not in themselves necessarily indicate the need for a change in management practices, because some soils have physical limitations which hold the productivity low.

TABLE 2.—WARREN COUNTY SOILS: AVERAGE YIELDS TO BE EXPECTED OVER A PERIOD OF YEARS UNDER GOOD MANAGEMENT

(Figures in bold face are averages from Farm Bureau Farm Management Service records; others are estimated yields.)

Type No.	Type name	Open-pollinated corn	Oats	Winter wheat	Soy-beans	Alfalfa
		bu.	*bu.*	*bu.*	*bu.*	*tons*
8	Hickory gravelly loam, eroded[1]	....	....	....	....	....
17	Berwick silt loam	38	34	20	20	1¾
18	Clinton silt loam	**40**	**38**	**22**	22[2]	**2¼**
36	Tama silt loam	**48**	**38**	**24**	24[2]	2½
41	Muscatine silt loam	**54**	**46**	**26**	**28**	**2¾**
43	Grundy silt loam[3]	**54**	**46**	**26**	**28**	2½
44	Monmouth silt loam[3]	54	46	26	28	2½
45	Denny silt loam	38	34	20	20	1½
51	Kern silt loam, terrace	38	34	20	20	1¾
65	Grundy clay loam[3]	**54**	**46**	**26**	**28**	2¼
67	Harpster clay loam	54	44	24	26	2¼
73	Huntsville loam, bottom	(4)	(4)	(4)	(4)	(4)
80	Alexis silt loam, terrace	48	38	24	24	2½
81	Littleton silt loam, terrace	52	44	26	28	2¾
107	Swan clay loam, bottom[3]	(4)	(4)	(4)	(4)	(4)
134	Camden silt loam, terrace	40	38	22	20	2¼
139	Hersman silt loam, terrace	54	46	26	28	2¾
195	Hersman clay loam, terrace	54	46	26	28	2½

[1]Not adapted to cropping.
[2]Crop not adapted without use of special erosion-control measures.
[3]Soil-type name subsequently changed; see footnote under discussion of type.
[4]Crops occasionally damaged by flooding. In normal years yields are about the same as for Grundy clay loam.

But a difference between the average yields on a given farm and the productive level of the soil types under cultivation on that farm as shown in Table 2 does indicate need for a change in management practices, including changes in soil treatment.

No soil, no matter how productive when first brought under cultivation, will maintain high yields of the grain crops for an indefinite time without the addition of certain materials. Yield records since 1887 on the Morrow plots show that when corn is grown continuously without soil treatment or catch crops, good yields are not maintained. These plots on the campus of the University of Illinois are located on soil similar in appearance and inherent productivity to Muscatine silt loam, a soil type which occurs extensively in Warren county.

Liming.—If alfalfa, sweet clover, or red clover cannot be grown because of soil acidity, this condition should be corrected as the first step in soil improve-

ment. Each field should be systematically tested and limestone applied where needed. Detailed instructions for collecting soil samples and making acidity tests are given in Illinois Circular 346, "Test Your Soil for Acidity."[1] Further information about the use of limestone is found in a mimeographed folder, "Limestone, the Key to Soil Conservation." The county farm adviser may be consulted about such testing work.

Nitrogen and Organic Matter.—In many soils, particularly soils low in organic matter, nitrogen is the most important limiting plant-food element. Since deficiencies of nitrogen and organic matter are often associated directly with soil acidity, the chief reason for applying limestone is that legume crops can then be grown and these crops carry nitrogen-fixing bacteria on their roots. A full discussion of this subject is given in Circular 326, "A Nitrogen Factory on Every Farm."

Under a livestock system, where the major portion of the grain and hay grown on the farm is fed to livestock and the manure returned to the fields, a satisfactory nitrogen level usually can be maintained without additional treatment provided a good rotation is used and crop residues are plowed under. Circular 465, "Pasture Improvement and Management," and a mimeographed folder entitled "Five Steps in Pasture Improvement" contain much information of value to the livestock farmer.

When a grain system of farming is followed, it is necessary to grow and plow under leguminous green-manure crops if an adequate nitrogen supply is to be maintained. Sweet clover is a very effective crop for green-manuring. Bulletin 394, "Sweet Clover in Illinois," will help to give an understanding of the requirements of this crop.

Phosphate and Potash.—The next step in soil improvement, after any need for lime and nitrogen is supplied, is to test for phosphate and potash deficiencies. Instructions for taking samples and making the phosphate test are given in Circular 421, "Testing Soil for Available Phosphorus." The results of this test are sometimes difficult to interpret properly, and it is therefore suggested that the county farm adviser be consulted for assistance in making and interpreting the test. The potash test is more difficult to make than the phosphorus test, and consequently it is not recommended that anyone attempt to make his own potash tests unless he is willing to spend some time and money acquiring the proper equipment and learning the proper operating technic. A method for making this test is explained in a mimeographed folder, "The Illinois Potash Test," which can be obtained on request.

When both phosphate and potash are low, the application of either one by itself usually results in disappointing yields. For maximum yields of all crops it is therefore essential to maintain adequate supplies of both available phosphate and potash, as well as nitrogen, thruout the growing season. If any one of these three elements is not present in sufficient amounts, crop yields will be reduced no matter how ample may be the supply of the other two.

Where the soils are fairly productive, reasonably large returns of barnyard manure will maintain the available-potash supply at a sufficiently high level for a

[1]Illinois publications mentioned in this report may be obtained free of charge by addressing the ILLINOIS AGRICULTURAL EXPERIMENT STATION, Urbana, Illinois.

considerable time. The supply of available phosphate will also be greatly helped by large applications of manure. But where 50 percent of the land is in corn each year or where the soils are not reasonably productive, continued high yields cannot be expected unless supplementary applications of phosphate and potash fertilizers are made.

If a grain system of farming is followed, it is particularly important that some attention be paid to nitrogen, phosphate, and potash deficiencies. Best yields will be obtained by plowing under a stand of sweet clover at frequent intervals and adding phosphate and potash fertilizers when needed.

Erosion Control.—Finally, the long-time effects of soil erosion must be given serious consideration even on moderately sloping land. It is essential in reducing erosion losses to keep a good cover of vegetation on the land as many months of the year as possible, but particularly during the winter and early spring. Since this cannot be done satisfactorily on poor soils, the application of limestone, phosphate, and potash as needed must be part of any permanent erosion-control program for such soils. Suggestions for methods to use on specific soil types are given in the *Use and Management* paragraph under each type needing such protection. More detailed information regarding erosion control will be found in Farmers' Bulletin 1795, "Conserving Corn-Belt Soils," published by the U. S. Department of Agriculture, Washington, D.C., and in Illinois Circular 513, "Save the Soil With Contour Farming and Terracing."

SOIL TYPES OF WARREN COUNTY: THEIR USE, CARE AND MANAGEMENT

A brief description of the outstanding characteristics of each soil type as mapped in Warren county, together with some general recommendations as to its use, care, and management, is given on the following pages. Some of this information is summarized in Table 3, page 29.

The recommendations made for the management of the respective types are based on their requirements for the efficient production of the crops common to the region. Such matters as the growing of special crops, the location of the land with respect to markets, and other economic considerations have not been taken into account.

In order to outline a complete soil-improvement and management program for a single field or farm, it would be necessary to know not only what soil types are involved but also what cropping and management practices have been followed in the past as well as what type of farming is to be followed in the future. Obviously not all this information is available. The major purpose of this report is, therefore, to furnish such basic information about the various soil types as will enable a farmer to lay out his own program of management and improvement for the soils that occur on his farm.

Hickory gravelly loam, eroded (8)

Hickory gravelly loam, eroded, occurs on steep topography where the slope is greater than 15 percent. Such areas are commonly found along the stream

bluffs and deep gullies leading away from the bottomland. Tho not extensive, this type is important in various parts of the county, occupying a total area of nearly 11 square miles.

In undisturbed forest areas, where erosion has remained at a minimum, there are sometimes thin soil horizons present. These usually include 2 to 3 inches of brownish-yellow silt loam surface with an occasional scattering of pebbles, 2 to 3 inches of yellowish subsurface, and 5 to 10 inches of reddish-yellow silty clay loam subsoil. Beneath the subsoil may be a layer of loess of variable thickness, below which lies leached pebbly till. However, any portion or all of the soil horizons and silty loess layers may have been removed by erosion and as a consequence the leached pebbly till, or in some cases even the underlying bedrock, may be exposed.

Use and Management.—The best use of Hickory gravelly loam, because it occurs on steep slopes and is easily damaged by erosion, is for timber and pasture. Slopes of less than 30 to 40 percent may be used for permanent pasture provided overgrazing is avoided. On areas already badly eroded or on slopes greater than 30 to 40 percent, plantings of hardy native trees such as oak, hickory, red cedar, and perhaps black locust, should be made. Black locust, while being the most suitable for erosion control, may be seriously damaged by borers. It should therefore be classed as a temporary vegetative cover, and trees of a more permanent nature should be planted as there is opportunity to do so.

Interest in the preservation and increase of wildlife will suggest the planting of native shrubs and vines in gullies. This type of planting will not only help to control erosion but will also furnish food and cover for birds and wild animals.

Berwick silt loam (17)

Berwick silt loam is a light-colored soil that has developed under forest vegetation on nearly level to undulating topography or where the slopes are not greater than 2 percent. It occurs in association with Clinton silt loam and covers a total area of about 10 square miles in Warren county.

The surface is a brownish-gray to yellowish-gray silt loam 6 to 8 inches thick, low in organic matter, and strongly acid in reaction. In some areas the timbering has been rather light, and here the surface is darker, being more nearly a grayish brown. The subsurface is a pale yellowish-gray silt loam 6 to 8 inches thick. The subsoil is a yellowish-gray medium-plastic clay loam 12 to 18 inches thick. It breaks readily into ¼- to ¾-inch subangular gray-coated aggregates. Beneath the subsoil the material is a permeable silt that becomes calcareous at a depth of 6 to 8 feet. Small gritty brownish-black iron-manganese pellets occur in abundance on the surface and thruout the soil profile. These concretions are frequently called buckshot, and the land over which they are scattered is known locally as "buckshot land."

Use and Management.—Berwick silt loam is not a highly productive soil tho satisfactory crop yields are often secured after its acidity has been corrected and barnyard or green manure has been applied. Those portions of the type that have slow surface drainage are also likely to have rather slow underdrainage, but for the most part drainage is not a serious problem.

This soil produces good pasture following proper soil treatment. Without such treatment, however, results are often disappointing. Some areas which are now in standing timber may yield larger returns than if cleared. Circular 477, "Forest Planting on Illinois Farms," will be found very helpful in planning a management program for such areas.

Clinton silt loam (18)

Clinton silt loam is a light-colored soil that has developed under forest vegetation on gently rolling to strongly rolling topography. It occurs generally as a

FIG. 4.—A GENTLY ROLLING AREA OF CLINTON SILT LOAM

The good stand of corn on the right shows that this soil, altho not naturally very productive, can be so managed that it will yield well. Steeper slopes of Clinton should not be cultivated extensively because of the danger of erosion.

belt of varying width bordering the eroded stream bluffs. It is one of the important types in the county, occupying a total area of nearly 84 square miles.

In undisturbed areas where erosion has not been active, the surface is usually 5 to 7 inches thick and is a grayish-yellow silt loam low in organic matter and strongly acid in reaction. The subsurface is 4 to 7 inches thick and is a grayish-yellow to yellow silt loam. The subsoil is 12 to 18 inches thick and is a grayish-yellow to yellow medium-plastic silty clay loam which breaks into ¼- to ½-inch rounded or nut-like aggregates. Beneath the subsoil the material is a permeable silt which is calcareous at a depth of 6 to 8 feet. Where erosion has been active, a part or all of the upper soil horizons are absent and in some cases the subsoil is exposed.

Use and Management.—Surface drainage of Clinton silt loam is moderate to rapid, while underdrainage is moderate. The steeper slopes are subject to considerable erosion and should not be cultivated intensively. Many of them should remain in permanent pasture; tho if erosion has progressed to the stage where a stand of grass cannot be established, it may be necessary to plant trees to stop further erosion. This soil is often seriously injured by gully head-cutting. The

FIG. 5.—GOOD USE OF A SLOPING AREA OF CLINTON SILT LOAM

A thick growth of pasture is preventing erosion on this 10-percent slope. In Fig. 6 note loss of soil on a similar field planted to corn.

control of this difficulty frequently requires the construction of check dams or diversion terraces in order to establish a sod or, in extreme cases, to get trees started.

Clinton silt loam responds well to treatment tho it is not naturally a very productive soil. The first step in an effort to increase yields is to correct acidity by applying limestone as indicated by the test. Following this a rotation should

FIG. 6.—POOR USE OF A SLOPING AREA OF CLINTON SILT LOAM

The erosion on this field was caused by the growing of corn. An area of this kind should be in grass (Fig. 5), or if the erosion has been too active, it may be necessary to plant trees.

be adopted which includes the frequent growing of clover or alfalfa to be used as pasture or green manure. Barnyard manure gives excellent results on this soil but there is rarely enough available to make it possible to dispense with legume green-manure crops. If the clovers are used without barnyard manure, it frequently becomes necessary to use phosphate and sometimes potash fertilizers to compensate for the increased removal of these nutrients.

Tama silt loam (36)

Tama silt loam is a dark-colored soil that has developed under grass vegetation on gently rolling to strongly rolling topography. It occurs thruout the county, generally as a belt around Clinton silt loam or along the drainage ways where Clinton does not occur. It is the second most extensive type in the county, occupying a total area of about 152 square miles.

Where erosion has not been active, the surface is 5 to 7 inches thick and is a brown to light-brown silt loam medium high in organic matter and medium acid in reaction. The subsurface is a brownish-yellow silt loam 4 to 7 inches thick. The subsoil is a reddish- or brownish-yellow silty clay loam 12 to 18 inches thick that breaks into ¼- to ½-inch rounded or nut-like aggregates. Beneath the subsoil is permeable silt, which becomes highly calcareous at a depth of 5 to 7 feet. Where erosion has been active, a portion or all of the upper horizons may be absent. Since most of the slopes found on Tama silt loam were the result of erosion and not of constructional processes, they are generally short and are therefore not separated from Tama and shown as a steep phase on the accompanying map. This wide range in topography and erodibility which Tama presents as it is mapped in Warren county is a variation that cannot readily be indicated on a map of the scale it was necessary to use in this county.

Use and Management.—On the less rolling areas Tama silt loam is a good general farming soil when well handled. Surface drainage is rapid, while underdrainage is moderate and tile drainage is unnecessary. A test should be made for acidity, and limestone applied as indicated by the test. This soil is particularly well adapted to alfalfa, and this legume or one of the clovers should have a regular place in the rotation. The legumes may be so handled as to serve as a cover for the land during the winter and early spring months and thus help to decrease erosion as well as to maintain the supply of organic matter. Phosphorus and potash may become deficient after legumes have been grown for a time. If the productivity level of this soil is not satisfactorily high after a good rotation has been established, tests should be made for available phosphorus and potassium, as a deficiency of one or both of these nutrients is indicated. Barnyard manure gives good results on Tama silt loam.

The more rolling areas of Tama silt loam often require special attention. Fall plowing of these areas should be avoided, as a protective cover of vegetation is needed during the winter and early spring. Under a livestock system no better use can be made of the steeper slopes than to keep them in permanent pasture. If cultivation is necessary, unusual precautions should be taken to decrease erosion. Where corn is grown, the stalks should be rolled crossways to the slope. This simple practice is often very effective in helping to reduce erosion. Grass

waterways should be provided and contour farming practiced as far as possible. If the slope is not too steep, terraces may be constructed to good advantage. If, however, erosion has removed so much of the loess as to bring the underlying leached glacial till near the surface, the advisability of terracing is questionable.

FIG. 7.—ACTIVE EROSION ON A FIELD OF TAMA SILT LOAM

Altho Tama silt loam is a good soil and the slope shown here is not particularly steep, the field is being seriously damaged by injudicious cropping. If corn is grown on areas such as this, it should be planted on the contour.

Careful study of the yielding capacity of Tama silt loam on a number of Illinois farms indicates that under good management (as defined on page 27) open-pollinated corn may be expected to average about 48 bushels an acre; oats, 38 bushels; winter wheat, 24 bushels; and soybeans, 24 bushels. (See Table 2, page 12, where the yields to be expected from the various soil types of Warren county are indicated.)

Muscatine silt loam (41)

Muscatine silt loam is a dark-colored soil that has developed under grass vegetation on undulating to gently rolling topography, where the slopes range between about 1 and 3½ percent. It occurs thruout the county in association with Tama silt loam and is the most extensive type in the county, covering a total area of 166 square miles.

The surface, which varies from 7 to 10 inches in thickness, is a brown to dark-brown silt loam high in organic matter and medium acid in reaction. The subsurface is a yellowish-brown silt loam 7 to 9 inches thick. The subsoil is a yellowish-brown silty clay loam 10 to 16 inches thick, which breaks into ¼- to ½-inch faintly dark-gray coated subangular aggregates. Noncalcareous permeable silt, which becomes highly calcareous at a depth of 4 to 6 feet, lies beneath the subsoil. The entire profile absorbs water readily and is readily penetrated by plant roots.

Use and Management.—Muscatine silt loam is a productive soil and needs

FIG. 8.—TEMPORARY PASTURE ON MUSCATINE SILT LOAM

Muscatine silt loam is a good soil and yields well under proper treatment. This pasture will probably be plowed for corn next year.

only good farming and proper treatment to produce high crop yields. Natural drainage is moderate, and tho harmful erosion may occur on the more rolling portions of the type, it may be satisfactorily controlled by good farming methods.

This soil is more durable than Tama silt loam and will stand more abuse without immediately disastrous results. The maintenance of a high productive level, however, cannot be expected without the application of limestone, phosphate, and potash in amounts indicated by the tests and the use of a good rotation. If barnyard manure is available, it will help materially to maintain productivity and decrease the need for phosphate and potash.

A stand of red clover often can be obtained on Muscatine in favorable seasons without limestone, but the stand is more certain and a better growth is usually obtained after a limestone application. For alfalfa and sweet clover an application of limestone is usually necessary.

Fall plowing should be avoided on slopes greater than 2.5 or 3 percent, while the more nearly level portions should be tile-drained. Results from the Kewanee soil experiment field in Henry county, shown below, indicate the relative effective-

Treatment[a]	*Corn (24 crops)*	*Oats (24 crops)*	*Wheat (21 crops)*	*Hay (22 crops)*
	bu.	*bu.*	*bu.*	*tons*
None	60	53	28	1.6
Manure	75	65	33	2.2
Manure, lime	80	66	36	2.4
Manure, lime, rock phosphate	81	66	40	2.6
None	58	55	29	1.7[b]
Residues	64	54	31	1.4[b]
Residues, lime	73	58	34	1.6[b]
Residues, lime, rock phosphate	76	63	40	1.9[b]
Residues, lime, rock phosphate, potash	77	63	40	1.9[b]

([a]Manure, 1 ton for each ton of crops grown; crop residues, stover, straw, legumes; limestone, 519 pounds an acre annually; rock phosphate, 340 pounds an acre annually; muriate of potash, 88 pounds an acre annually. [b]Average of 14 crops: 2 cuttings removed each year from the check plot and only one from the treated plots.)

ness of the fertilizer treatments that have been used on this field, which is on Muscatine silt loam.

Under farm conditions, with good management, the following yields may be expected, as an average, from Muscatine silt loam, judging from studies carried on by the Department of Agronomy with the cooperation of the Department of Agricultural Economics: open-pollinated corn, 54 bushels; oats, 46 bushels; winter wheat, 26 bushels; and soybeans, 28 bushels (Table 2, page 12).

Grundy silt loam (43)[1]

Grundy silt loam is a dark-colored soil that has developed under a heavy prairie grass vegetation on gently undulating topography or on slopes between ½ and 1 percent. It occupies about 41 square miles in Warren county.

The surface horizon, which is 8 to 10 inches thick, is a dark-brown faintly granular silt loam to silty clay loam that is high in organic matter and nitrogen and slightly acid to neutral in reaction. The subsurface is a dark grayish-brown silty clay loam 7 to 9 inches thick. The subsoil is a dark gray silty clay 10 to 16 inches thick, splotched and spotted with yellow, which breaks into ¼- to ½-inch dark coated subangular aggregates. The loessial material immediately beneath the subsoil is usually noncalcareous for a few inches but almost always is highly calcareous at a depth of 3½ to 4 feet.

This soil is easily penetrated by plant roots and absorbs and retains moisture readily.

Use and Management.—Grundy silt loam, if well drained, is a very productive soil and, like Muscatine, needs only good farming and proper treatment to produce high crop yields. Surface drainage is moderately slow and erosion is negligible. Tile draw well, but it is sometimes difficult to provide a good outlet because of the topographic position of the type and distance to natural drainage ways. All crops common to the region do well on this soil.

Grundy silt loam is a durable soil but good farming practices must be followed, including a good rotation, if its productivity level is to remain high. A satisfactory stand of red clover usually can be obtained without the use of limestone. In favorable years some alfalfa and even sweet clover will survive; but for best results, especially with sweet clover, a light application of limestone should be made. Results from the Aledo soil experiment field in Mercer county indicate the relative effectiveness of different fertilizers on this soil type.

Treatment[a]	*Corn (28 crops)*	*Corn (16 crops)*	*Oats (27 crops)*	*Hay or wheat*[b]
	bu.	*bu.*	*bu.*	*(T) or bu.*
None	58	60	56	(2.0)
Manure	74	74	64	(2.4)
Manure, lime	76	78	66	(3.0)
Manure, lime, rock phosphate	76	78	67	(3.0)
None	57	61	56	28
Residues	64	67	58	30
Residues, lime	74	73	63	34
Residues, lime, rock phosphate	76	74	64	36
Residues, lime, rock phosphate, potash	78	77	67	37

([a]See footnote *a* on opposite page. [b]Hay, 14 crops; wheat, 25 crops.)

[1]Subsequent to the printing of the Warren county soil map the name Grundy silt loam, as applied to soil areas in Warren county, was changed to Sable silt loam.

Monmouth silt loam (44)[1]

Monmouth silt loam is a dark-colored soil that has developed under slough-grass vegetation on nearly level to undulating topography. It is not an extensive type in Warren county, occupying a total area of slightly less than 4 square miles. It occurs west of Monmouth as an irregularly shaped area.

The surface, which is 7 to 10 inches in thickness, is a dark-brown faintly granular silt loam to silty clay loam very high in organic matter and, for the most part, neutral in reaction. The subsurface is a dark grayish-black clayey silt loam 6 to 8 inches thick. The subsoil is a brownish-gray yellow-spotted slightly plastic silty clay loam 10 to 16 inches thick. A zone or band of lime concretions frequently exists at a depth of 28 to 32 inches, and the silty material beneath the subsoil is generally calcareous at a depth of 3 feet. Plant roots easily penetrate the entire profile of this type and moisture is readily absorbed.

Use and Management.—Monmouth silt loam is similar to Grundy silt loam except that it is calcareous (high in lime) immediately beneath the subsoil and therefore probably also higher in lime in the upper portions of the profile than Grundy. The treatment and management suggestions for Grundy silt loam (page 21) apply to Monmouth also, and the yields to be expected are probably comparable.

Denny silt loam (45)

Denny silt loam is a medium-dark soil that has developed under scanty grass and weed vegetation on nearly level or slightly depressional topography. It is a very minor type in Warren county, occupying a total area of only about ¼ square mile.

Altho the total area of Denny is small, it is an important soil since it is relatively poor yet occurs in association with two very productive soils, Muscatine silt loam and Grundy silt loam. It occurs generally as small isolated or disconnected spots which are often smaller than an acre in size. For this reason many individual spots are not shown on the soil map. Where several spots occur close together, they are shown as one area.

The surface is a grayish-brown silt loam 7 to 9 inches thick, medium in organic matter and acid in reaction. The subsurface is a dark-gray or brownish-gray silt loam 5 to 8 inches thick. The subsoil is a gray plastic silty clay 14 to 22 inches thick which in the upper portion breaks into ¼- to ¾-inch dark-coated subangular aggregates. The aggregates become larger and more irregular in appearance below 2 feet and tend to disappear at about 3 feet. Beneath the subsoil the material is a leached, or noncalcareous, friable silt which becomes calcareous at a depth of 6 to 8 feet.

Use and Management.—Plant roots do not easily penetrate the subsoil of Denny silt loam, and water is not readily absorbed. Tho many of these spots occur at the heads of small draws, they are frequently wet and difficult to farm. Also, since the plastic subsoil tends to limit the effectiveness of tile, the response of crops to soil treatment is often disappointing. Sweet clover will grow after soil acidity has been corrected; and frequent applications of manure will help to

[1]After the printing of the Warren county soil map, the name Monmouth was changed to Hartsburg.

raise the productivity level. Special treatment of Denny silt loam is often not practicable because this soil occurs in small areas in association with soils not requiring special treatment. When limestone is applied to a field in which spots of Denny occur, a double application can be made to these spots without much extra

FIG. 9.—AN AREA OF DENNY SILT LOAM IN A FIELD OF MUSCATINE SILT LOAM
The light-colored soil in the background is Denny silt loam, a relatively poor claypan soil. It usually occurs, as it does here, in small spots in association with a better soil. Because it occurs in such small areas it must ordinarily be cropped in the same way as the soil with which it is associated.

labor. The same cropping system must ordinarily be followed on Denny as on the soil with which it is associated, which in Warren county is usually Muscatine silt loam (see page 19).

Kern silt loam, terrace (51)

Kern silt loam, terrace, is a light-colored soil derived from a cover of loess over stratified sand and gravel. It has developed on the nearly level or slightly depressional portions of some of the timbered terraces and occupies a total area of slightly less than ½ square mile in Warren county.

The soil-profile characteristics are similar to those of Berwick silt loam except that sand or gravel underlies Kern silt loam, terrace, at a depth of 6 or 7 feet.

Use and Management.—Kern silt loam, terrace, requires the same management and treatment as Berwick silt loam (see page 15).

Grundy clay loam (65)[1]

Grundy clay loam is a dark-colored soil that has developed under slough- or marsh-grass vegetation on nearly level or slightly depressional topography where slopes are less than about ½ percent. It occurs in association with Grundy silt loam and occupies a total area of nearly 22 square miles in Warren county.

[1]Subsequent to the printing of the Warren county soil map the name Grundy clay loam, as applied to soil areas in Warren county, was changed to Sable silty clay.

The surface, which is 8 to 12 inches thick, is a black granular silty clay that is very high in organic matter and neutral in reaction. The subsurface is a dark grayish-black silty clay 6 to 8 inches thick. The subsoil, which is 10 to 18 inches thick, is a gray to dark-gray silty clay spotted and splotched with yellow and tends to break into ¼- to ½-inch subangular aggregates. A few inches of noncalcareous silt usually occur immediately beneath the subsoil. At a depth of 3½ to 4 feet the loessial material is highly calcareous.

Use and Management.—This soil needs artificial drainage before it can be farmed properly, tho for the most part adequate tile drainage has already been established. The surface is heavy, and if plowed when too wet and sticky becomes cloddy.

Grundy clay loam is highly productive when well drained and well farmed. It is well adapted to growing corn. In favorable years red clover and sweet clover grow well without treatment. However, after a number of years of grain farming in which no clover has been grown, an application of limestone may be necessary to secure a good stand of clover. Small grains frequently lodge on this soil, particularly in years that are very favorable for heavy straw growth. Regular additions of barnyard manure or growing and plowing under green-manure crops will help to keep this soil in good physical condition and to keep crop yields at a high level. The yields which may be expected on this soil are probably comparable to those secured on Grundy silt loam (Table 2, page 12).

Harpster clay loam (67)

Harpster clay loam is a dark-colored soil that has developed under slough- or marsh-grass vegetation on nearly level or slightly depressional topography. It occurs in association with Grundy clay loam, usually as small isolated spots tho sometimes as a group of spots or as a narrow band around the base of a knoll or around the edge of a pond-like depression. It is a minor type in Warren county, occupying a total area of only ½ square mile. Actually it is somewhat more extensive than this, however, for many of the single spots smaller than an acre could not be drawn to scale on the map and consequently are included with Grundy clay loam.

This soil is youthful and has no well-defined horizons. It is differentiated from the other soils with which it is associated chiefly by the large accumulation of snail shells and shell fragments which give to the surface a high free-lime content. In general the surface varies from 5 to 10 inches in thickness and is a black to grayish-black silty clay loam to silty clay. It is high in organic matter and alkaline in reaction. The grayish color and high alkalinity are both due to the accumulation of shell fragments. The subsurface and subsoil are not readily distinguished, but are generally a gray to dark-gray silty clay loam, often spotted or splotched with yellow. They are usually alkaline in reaction. Below 35 or 40 inches the material is friable calcareous silt.

Surface drainage is slow and underdrainage is moderate tho a good tile outlet is not always available.

Use and Management.—The topography of Harpster clay loam is frequently depressional, so that water tends to collect following heavy rains. When this is

the case, it is particularly important to provide adequate drainage, otherwise crops will drown out in these areas.

This soil is usually deficient in available potash. Where this is true, the grain crops, especially corn, respond well to applications of high-potash fertilizers. Straw and coarse manure are useful in helping to correct this condition. Small grains tend to lodge, but this tendency usually can be partially corrected by the use of fertilizers high in potash and available phosphorus.

Huntsville loam, bottom (73)

Huntsville loam, bottom, is a dark-colored soil derived from recently deposited mixed silty and sandy alluvial sediments washed from the upland slopes. It occupies a total area of slightly more than 39 square miles in Warren county.

This type shows little or no profile development. In general the surface is a

FIG. 10.—HUNTSVILLE LOAM, BOTTOM, IN ASSOCIATION WITH A SLOPING AREA OF CLINTON SILT LOAM

Good land use requires that both these areas be kept in pasture. The Huntsville (*foreground*) is in pasture because of the danger of overflow; and the Clinton (*right*) is in pasture because of its steep (12-percent) slope.

silt loam in texture, tho occasional areas are sandy or clayey. It varies from grayish yellow thru grayish brown to dark brown and grades with depth into brownish or yellowish gray. It is neutral or only very slightly acid in reaction and medium to high in organic-matter content.

Use and Management.—The uses to which Huntsville loam, bottom, is adapted vary because of difference in overflow hazard. Some portions of the bottomlands are wide, not subject to frequent overflow, and are sufficiently well drained to be readily cultivated. Other portions are too narrow or possibly too wet to be tilled and consequently should be used as pasture or timberland. No treatment is recommended for this soil because of the addition of sediment during overflow.

Alexis silt loam, terrace (80)

Alexis silt loam, terrace, is a medium-dark soil derived from a cover of loess over stratified sand and gravel. It has developed on the rolling portions of some of the terraces in association with Littleton silt loam and occupies a total area in Warren county of about ½ square mile.

The soil-profile characteristics are similar to those of Tama silt loam except that sand or gravel underlies this type at a depth of 6 or 7 feet.

Use and Management.—Alexis silt loam, terrace, requires the same management and treatment as Tama silt loam (see page 18).

Littleton silt loam, terrace (81)

Littleton silt loam, terrace, is a dark soil derived from a cover of loess over stratified sand or gravel. It has developed on the undulating to gently rolling portions of the dark-colored terraces and occupies a total area slightly exceeding a square mile in Warren county.

The soil-profile characteristics are similar to those of Muscatine silt loam except that sand or gravel underlies this type at a depth of 6 or 7 feet.

Use and Management.—Littleton silt loam, terrace, requires the same management and treatment as Muscatine silt loam (see page 19).

Swan clay loam, bottom (107)[1]

Swan clay loam, bottom, is a dark soil derived from heavy clay sediments. It is found mainly in the outer portions of the wide bottomlands and occupies a total area of slightly less than ½ square mile in Warren county.

This type shows little profile development because it is formed from recent alluvial sediments. The surface is a heavy black clay loam 10 to 18 inches thick and is very high in organic matter. It is neutral or slightly alkaline in reaction and contains an occasional concretion of lime. Beneath the surface the material is somewhat silty and grayish black to dark gray, with gray spots and concretions of calcium carbonate.

Use and Management.—Swan clay loam is similar to Grundy clay loam in management and treatment requirements (see page 23). Its use differs, however, because most of the areas are subject to occasional overflow and farming practices must be adjusted accordingly.

Camden silt loam, terrace (134)

Camden silt loam, terrace, is a light-colored soil derived from a cover of loess over stratified sand or gravel. It has developed on the undulating to rolling portions of the timbered terraces and occupies a total area of a little more than 2 square miles in Warren county.

The soil-profile characteristics are similar to those of Clinton silt loam, except that sand or gravel underlies this type at a depth of 6 or 7 feet.

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[1]After the printing of the Warren county soil map, the name Swan was changed to Sawmill clay loam, bottom.

Use and Management.—Camden silt loam, terrace, requires the same management and treatment as Clinton silt loam (see page 16).

Hersman silt loam, terrace (139)

Hersman silt loam, terrace, is a dark soil derived from a cover of loess over stratified sand or gravel. It has developed on nearly level to undulating topography in association with Littleton silt loam. It is a very minor type in Warren county, occupying a total area of only about 160 acres.

The soil-profile characteristics are similar to those of Grundy silt loam except that sand or gravel underlies this type at a depth of 6 or 7 feet.

Use and Management.—Hersman silt loam, terrace, requires the same management and treatment as Grundy silt loam (see page 21).

Hersman clay loam, terrace (195)

Hersman clay loam, terrace, is a dark-colored soil derived from a cover of loess over stratified sand or gravel. It has developed on nearly level to depressional topography in association with Littleton silt loam. It is a very minor type in Warren county, occupying a total area of only about 40 acres.

The soil-profile characteristics are similar to those of Grundy clay loam except that sand or gravel underlies this type at a depth of 6 or 7 feet.

Use and Management.—Hersman clay loam, terrace, requires the same management and treatment as Grundy clay loam (see page 23).

PRODUCTIVITY OF WARREN COUNTY SOILS

The approximate crop yields to be expected over a period of years from the different soil types in Warren county when well farmed are given in Table 2, page 12. The figures in bold type are average yields of harvested crops recorded by a selected group of farmers thru the years 1925 to 1940; the others represent estimated yields based on the physical properties of the soils.

With respect to corn yields it should be explained that these are for open-pollinated varieties rather than for hybrids since farmers' records of hybrid corn cover too short a period to give stable averages. On well-treated fields during the years 1936-1940 adapted hybrids averaged about 15 bushels an acre more than the open-pollinated varieties; and further improvement in hybrids may bring still higher yields if the soil is maintained in condition to support them.

Management practices that tend to produce the highest yields of corn will not always give the highest yields of other crops. Since, however, corn is the main cash crop in Warren county, it is to be assumed that the farmers of this county will wish to point their management practices toward high yields of this important crop. The figures shown in Table 2 and the recommendations made in the text of this report are based on this assumption. Following are the main characteristics of these management practices: (1) use of good crop varieties adapted to the region; (2) use of a suitable rotation—one that minimizes erosion and includes clover at least once in each three- or four-year period; (3) return

of barnyard or green manure to the soil to maintain an adequate supply of nitrogen and organic matter; (4) testing of the soil and application of lime, phosphorus, or potash, or any combination of these three substances, where needed; (5) exercise of reasonable care in seedbed preparation and in time and rate of planting; and (6) suitable practices for control of weeds, insects, and diseases.[1]

Because wide seasonal variations in rainfall, temperature, and wind cause wide variations in crop yields, two- or even three-year averages from a given farm cannot be compared with the ten- to fifteen-year averages in Table 2. Five-year or longer averages can, however, be so compared. So if a farmer finds his yields for such a period markedly below those in Table 2, he should study his management practices critically and see where the fault lies. The low yields may be due to a poor rotation, to poor soil treatment, or to poor cultural practices.

Were more intensive fertilizing practices to be followed than are now usually thought advisable on these soils, yields probably could be advanced beyond those shown in Table 2. Soluble fertilizers drilled with wheat will increase wheat yields in many years; and there is some evidence that mixed potash and phosphate fertilizers applied at corn-planting time will often add to corn yields.

So while yields below the levels shown in Table 2 are probably an indication of faulty management, yields as large as those shown in the table need not be considered the limit to what could be done with these soils.

SUMMARY OF CHARACTERISTICS OF WARREN COUNTY SOILS

The agriculturally more significant characteristics of the soil types shown on the accompanying colored map are summarized in Table 3. Since the information in this table is necessarily generalized, it should not be taken to mean that *every* farm or field of a given soil type will exhibit exactly the same characteristics as are here indicated. As already pointed out, productivity may vary markedly within areas of the same soil type because of differences in past management; and for that reason every field should be tested as recommended in the more detailed discussion of the types, and treatments should be based on the results of the tests.

In like manner, erosion susceptibility may vary widely in different areas of the same type. Areas in which the highly weathered Illinoian till or unweathered bedrock is already within 40 or 50 inches of the surface will be irreparably damaged if much of the remaining loessial material is eroded away. It is therefore very important that erosion-control measures, as well as soil-treatment and management practices, be adjusted to each individual field.

[1]For a more detailed discussion of cultural practices the reader is referred to Illinois Bulletin 444, "Farm Practices and their Effects on Farm Earnings," pages 480 to 510.

TABLE 3.—WARREN COUNTY SOILS: SUMMARY OF CHARACTERISTICS, PROPERTIES, AND ADAPTATION

Type No.	Type name	See page[1]	Topography[2]	Subsoil permeability[3]	Organic matter	Amendments commonly needed[4]	Workability[5]	Erosion susceptibility[6]	Drouth resistance
8	Hickory gravelly loam, eroded	14	Steep	....	Low	....	....	Very great	....
17	Berwick silt loam	15	Undulating	Slow to moderate	Low	LP	Good	Slight	Fair
18	Clinton silt loam	16	Rolling to strongly rolling	Moderate	Low	LP	Good to fair	Moderate to great	Fair
36	Tama silt loam	18	Rolling to strongly rolling	Moderate	Medium	LP	Good to fair	Moderate to great	Fair
41	Muscatine silt loam	19	Undulating to gently rolling	Moderate	High	L	Good	Slight	Good
43	Grundy silt loam[7]	21	Undulating	Moderate	High	None	Good to fair	None	Good
44	Monmouth silt loam[7]	22	Nearly level to undulating	Moderate	High	None	Good	None	Good
45	Denny silt loam	22	Nearly level	Slow	Medium	LP	Fair	None	Fair
51	Kern silt loam, terrace	23	Nearly level	Slow	Low	LP	Fair	None	Fair
65	Grundy clay loam[7]	23	Nearly level	Moderate	High	None	Fair	None	Good
67	Harpster clay loam	24	Nearly level	Moderate	High	K	Fair	None	Good
73	Huntsville loam, bottom	25	Nearly level	Moderate	Medium to high	None	Variable	Variable	Good
80	Alexis silt loam, terrace	26	Rolling	Moderate	Medium	LP	Good to fair	Moderate to great	Fair
81	Littleton silt loam, terrace	26	Gently rolling	Moderate	High	LP	Good	Slight	Good
107	Swan clay loam, bottom[7]	26	Nearly level	Moderate	High	None	Fair	None	Good
134	Camden silt loam, terrace	26	Gently rolling	Moderate	Low	LP	Good to fair	Moderate to great	Fair
139	Hersman silt loam, terrace	27	Undulating	Moderate	High	None	Good	None	Good
195	Hersman clay loam, terrace	27	Nearly level	Moderate	High	None	Fair	None	Good

[1]For description of soil type turn to page indicated.
[2]Topography is expressed by the following terms based on the respective slopes: *nearly level*, less than .5 percent slope; *undulating*, .5 to 1.5 percent; *gently rolling*, 1.5 to 3.5 percent; *rolling*, 3.5 to 7 percent; *strongly rolling*, 7 to 15 percent; *steep*, greater than 15 percent.
[3]Of the terms used, *moderate* expresses the most desirable condition.
[4]Soil amendments commonly needed to obtain yields given in Table 2: L = lime; P = phosphorus; K = potash.
[5]Workability is dependent on texture, organic-matter content, and structure of the surface horizon, as well as on slope and drainage.
[6]The terms used to describe erosion susceptibility indicate the relative susceptibility of the soils when under cultivation.
[7]Soil-type name subsequently changed; see footnote under the discussion of this type.

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68 Jasper, 1940
69 Cumberland, 1940
70 Warren, 1941

*(*Withdrawn from general circulation)*

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WARREN COUNTY
SOIL MAP

THE LOCATION of each soil type in Warren county is shown on this map, consisting of two sections, by a distinctive color and number. Where areas are too small to contain a number, the number is placed outside the area and a line drawn from it to the area. About a mile south of Monmouth there are several small areas of Grundy clay loam that are shown in this way. To help in locating a particular farm or region, various other identifying features such as streams, roads, railroads, towns, and even rural residences, schoolhouses, and churches are also indicated.

For a description of each soil type and a statement of its best use and recommended management, see pages 14 to 28, consulting *Contents,* page 2, for exact page references.

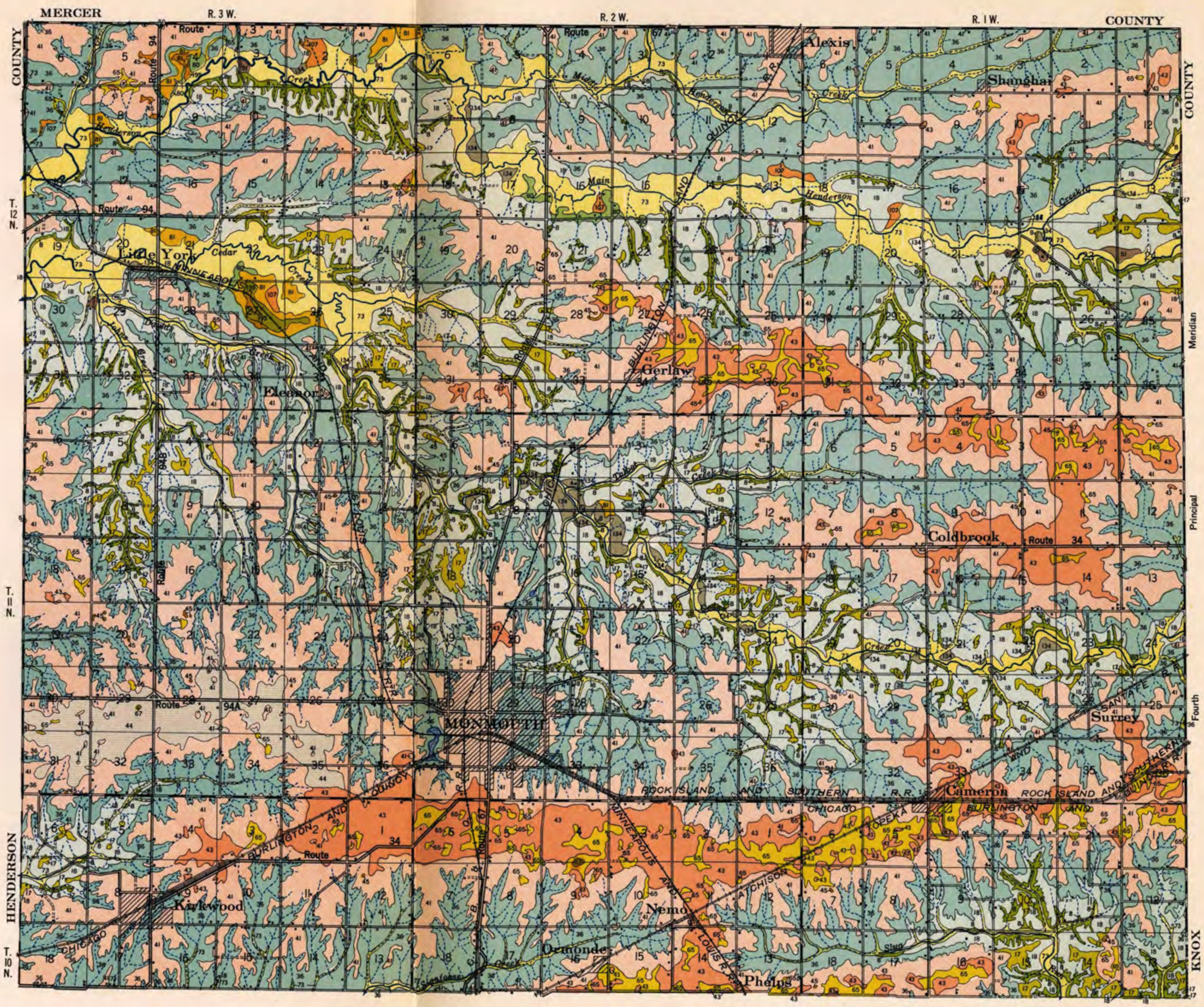
LEGEND

8	Hickory gravelly loam, eroded
17	Berwick silt loam
18	Clinton silt loam
36	Tama silt loam
41	Muscatine silt loam
43	Grundy silt loam
44	Monmouth silt loam
45	Denny silt loam
51	Kern silt loam, terrace
65	Grundy clay loam
67	Harpster clay loam
73	Huntsville loam, bottom
80	Alexis silt loam, terrace
81	Littleton silt loam, terrace
107	Swan clay loam
134	Camden silt loam, terrace
139	Hersman silt loam, terrace
195	Hersman clay loam, terrace

CONVENTIONAL SIGNS

House
Church
School house
Store building
Elevator
Railroads (steam)
Railroads (electric)
Paved Through Routes
Metalled (all weather) roads
Improved Dirt Roads
Secondary Dirt and Private Roads
Township boundary lines
County boundary lines
Streams (flowing)
Streams (intermittent)
Lake or Pond
Rock outcrop

Scale
0 ¼ ½ 1 2 Miles
1932



R. S. Smith, In Charge Soil Survey
E. A. Norton, Inspector

SOIL SURVEY MAP OF WARREN COUNTY

UNIVERSITY OF ILLINOIS AGRICULTURAL EXPERIMENT STATION

Soils Mapped by
Herman Wascher, in Charge
Eric Winters

Litho. Jahn and Ollier Eng. Co. Chicago
Carto. Huebinger Co., Chicago

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CONVENTIONAL SIGNS

- House
- Church
- School house
- Store building
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- Railroads (electric)
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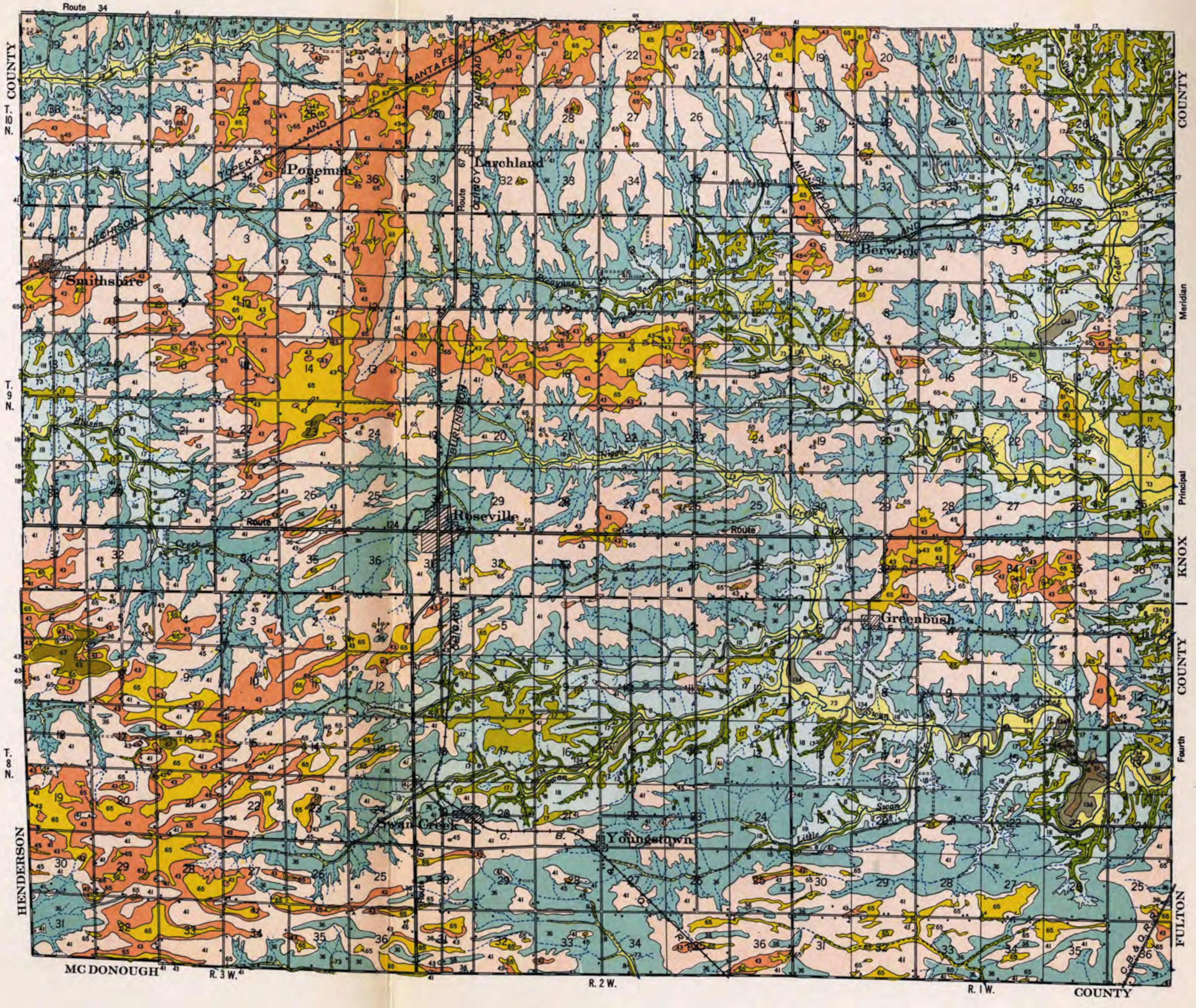

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